Introductory Organic Chemistry - II
Professor Doctor Harinath Chakrapani
Indian Institute of Science Education and Research, Pune
Lecture 52
Tutorial 7: Problems on Felkin-Ahn

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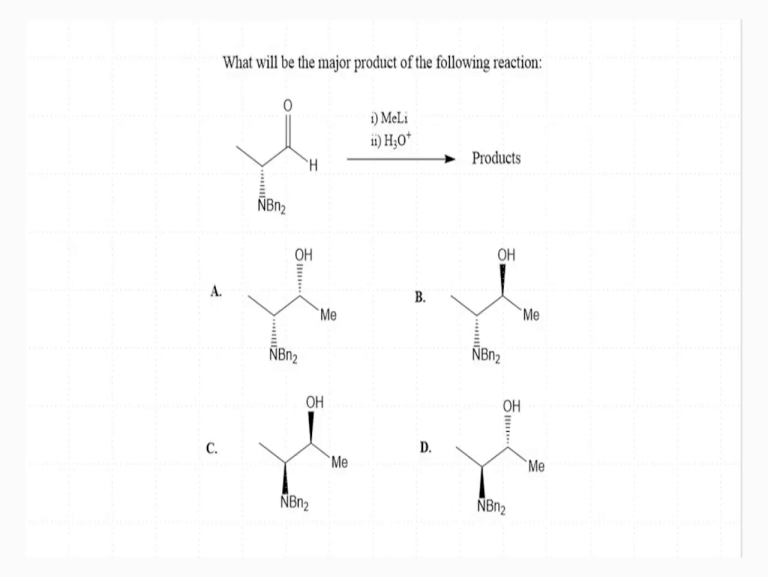

So, in this question here, what we are going to look at is the prediction, trying to predict the products that are formed. So, for the following aldehyde, what would be the major product that is formed. When you add as the first step, you add methyl lithium, and then the second step, you add a source of acid. So, there are four choices given here. And we need to figure out what the correct product is. Now, in order to answer this question, we need to, first of all understand that we need to use the Felkin-Ahn model for prediction.

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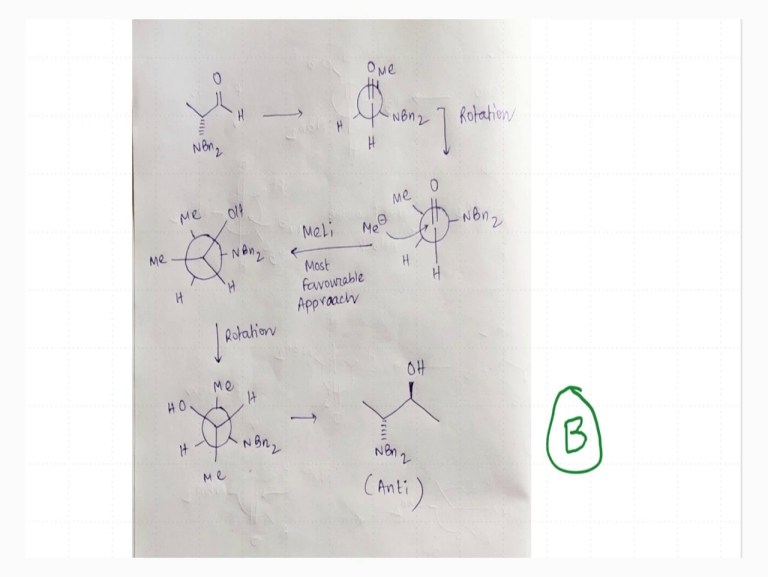

So, for this, you would need to, first of all draw the product, draw the starting material in the right orientation. So, if you look from here, the hydrogen is below, the carbonyl is above. And then, you know, the NBn_2 as drawn here is going into the plane of the paper. So therefore, if I look from here, then N-dibenzyl would be on the right. And the methyl group is eclipsing the carbonyl. So, it would be right behind there. And of course, the hydrogen which is not drawn here would be on the left.

So, I will repeat this. So, what we need to do is we need to draw the conformation appropriately. So, we will look at the structure from this direction. And so, when we look at it from this direction, the carbonyl is on top, the hydrogen is below. And the N-dibenzyl, which is going into the plane of the paper here will actually be on the right, the methyl group, which is fairly straightforward is eclipsing carbonyl over here, it will also be eclipsing over here, and the hydrogen is on the other side. Now, we need to rotate this in such a way that it is in the most reactive conformation.

So, we already know that when you have an electronegative group N-dibenzyl group so this is going to be at the perpendicular position and now the attack of Me minus comes in this using the Burgi-Dunitz angle, as shown here. And it is going to give you this product as shown here. Now, what you need to do is you need to rotate it, rotate this in such a manner that you are able to draw

it out exactly as shown in the choices. So, if you do this, then the methyl groups are actually going to be opposite to one another or anti to one another. And the other groups are going to be in the way that is shown here. So, the correct answer is the choice B.

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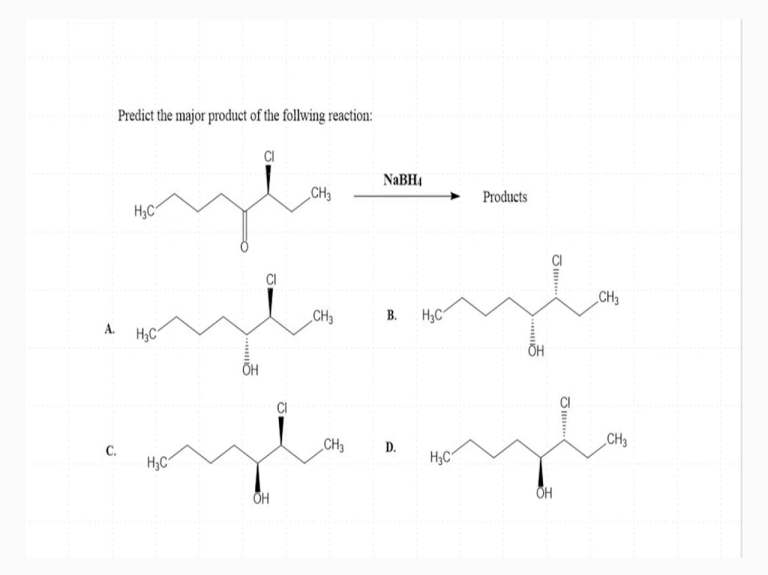

In the next problem, the question here is to predict again, the major product that is formed when this carbonyl compound is reacted with sodium borohydride. So, you are again, given four choices here, what you can do is to assign the absolute stereochemistry of the compounds as shown here. And then you can try and figure out if the stereochemistry is correct or wrong. So, this will help you to reason out the answer as shown in the choices. So, the first step here is again to draw out the carbonyl as we would have seen it.

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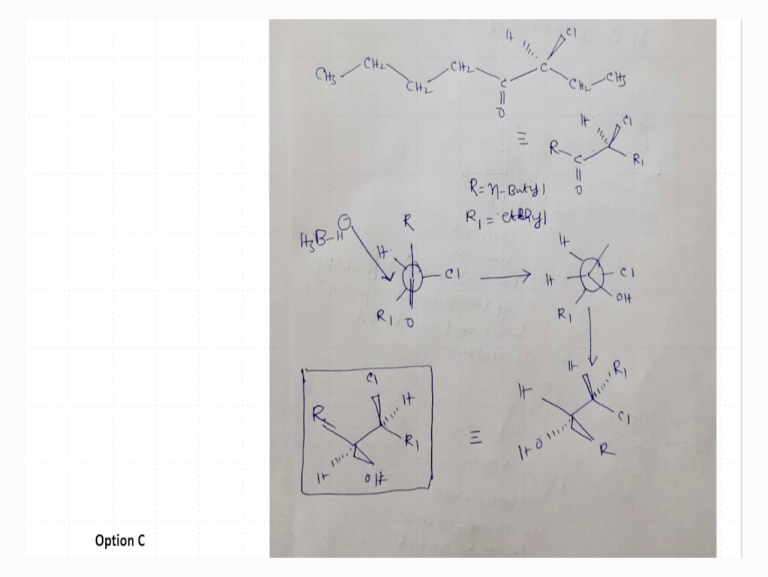

So, what we are doing is we are going to take a short cut, we are just going to call this long alkyl chain here as R. And then this ethyl group is going to be called as R_1. So, if you draw out the conformation as shown and what you will get is that the chlorine is facing us and the hydrogen is going inside the plane of the board, R_1 is on the right and the carbonyl is over here. So, if in this conformation, if you draw out the stereochemistry, as we would expect them the Felkin-Ahn model, then the carbonyl is below here, R is above.

And now if I look from here, the Cl is on the right, the hydrogen is on the left, and R_1 is here. So, this is the appropriate conformation for the attack by the nucleophile which is sodium borohydride because again, the electronegative atom is going to be perpendicular to the carbonyl. So, if you add it in this conformation, then the product that you get is shown here. And if I draw it out in the wedge form, it gives me this product, which the correct option is C.

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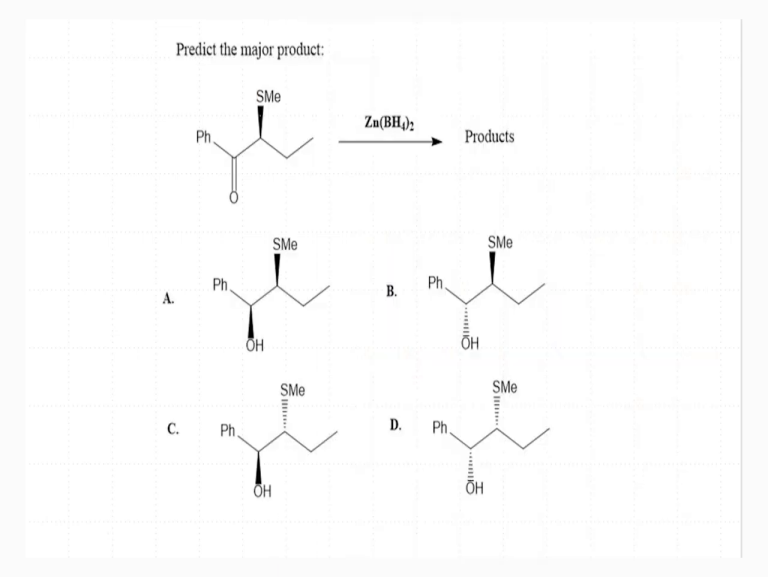

In the next problem, we again have a borohydride-based reduction reaction. So, here we are dealing with a derivative of an acetophenone. So, this again has a SMe group here, and you are adding zinc borohydride. And you are trying to figure out the products that are formed. Again, the strategy is very similar, you are saying R and S stereochemistry, I am not doing it in this solution over here, but you should do it. And when you get time, you should practice the entire problem from end to end.

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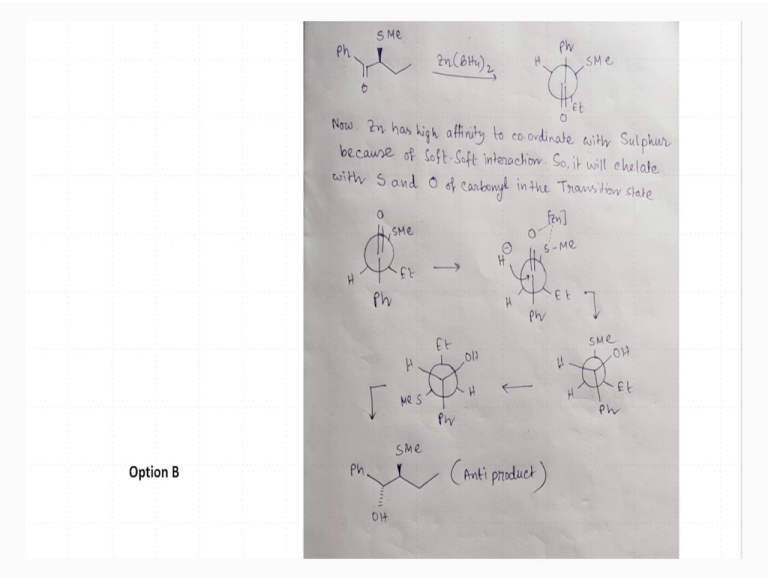

So, if we go ahead and look at the problem. Now, what we need to do is we need to draw the stereochemistry of the starting compound. And again, if you look at it from here, the phenyl is on top, the carbonyl is below. SMe is going to be, if I am looking at it from here, SMe is on the right, and hydrogen is on the left, and ethyl group is below.

Now, since zinc has a very high affinity to coordinate with sulphur, because of the soft-soft interaction, what we can predict is that the zinc is going to act as a chelating agent. And this chelating agent is going to sort of form this sort of a structure, which is going to increase the reactivity of that particular conformation. So, in that particular conformation, if the attack of hydride happens, then you are going to end up with this kind of a product where the OH is on the right, the hydrogen is on the left, the remaining back carbon actually remains the same.

And if I redraw this, and if I have to put it where the ethyl group and the phenyl group are actually going to be far away from each other or anti then the hydroxyl group is going inside the plane of the board, and SMe is, continues to be coming towards us. So again, here, the answer is option B.

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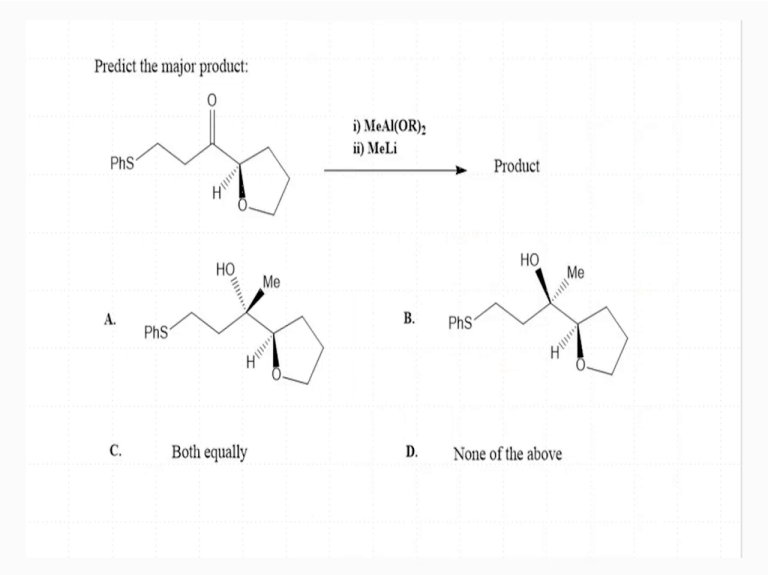

In the next question, we are going to look at a situation where we want to predict the major product again. So here, it is a very, very similar question again. So, you are adding methyl aluminum derivative, then second step is the addition of methyl lithium as a second additive.

Now, in order to address this question, again, I would assign here R and S, which I am not doing over here, so you guys should assign it.

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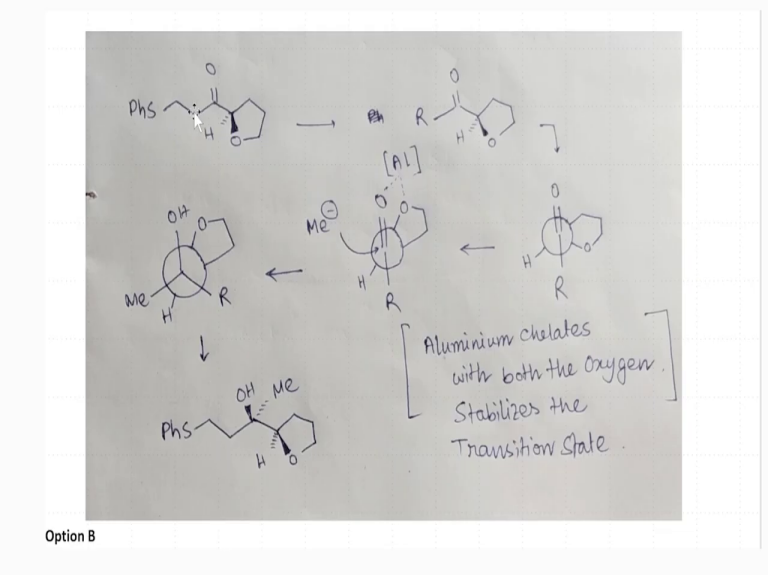

And then, if we go through the steps, what you will find here is that addition of aluminum has an important consequence, that aluminum is again, a chelating agent. So, the most reactive conformation is the one where aluminum is chelating to both the carbonyl as well as the oxygen. And so, this is going to be the most reactive conformation. And now if Me minus adds, you will end up with this product here, which if you redraw you get the structure here. And therefore, you are going to see that when you go back and look at the choices, this is going to correspond to choice B.